

THURSDAY, DECEMBER 13, 1900.

## ORGANOGRAPHY AND ITS RELATIONS TO BIOLOGICAL PROBLEMS.

*Organographie der Pflanzen, insbesondere der Archegoniaten und Samenpflanzen.* Von Dr. K. Goebel. Zweiter Theil. 2 Heft : Pteridophyta und Samenpflanzen. Mit 173 abbild. im text. Pp. xvi + 385 to 648. (Jena : Gustav Fischer, 1900.)

THE volume before us forms a further instalment of the large treatise on the organography of plants upon which Prof. Goebel is engaged. The part just published deals with the vegetative organs of the flowering plants, and, in a lesser degree, with the sporophyte and gametophyte of the vascular cryptogams.

It is needless to remark that the book teems with information, and, as might be anticipated, the author has drawn largely, for purposes of illustration, on the rich stores of material collected by him during his travels in various parts of the world. It is possible, however, that a layman on reading the book would arrive at the conclusion that in this particular field (of organography) other botanists had displayed far less activity than might have been expected from them, and would thus give them less credit than a closer acquaintance with either literature or the class-room would show they deserved.

The plan of the book is partly morphological, but woven into the morphological warp there is also the biological woof, and the author has emphasised, in a way which few could have done so well and, perhaps, no one more fully, the interdependence of these two groups of factors which so largely determine the actual form of existing plants. Goebel has long been known as an exponent of the concrete, and throughout the treatise one constantly finds traces of his antagonism towards that idealism into which, if the function of an organ be neglected, the morphologist is even still apt to stray.

Whilst tracing the various modifications which a given structure—e.g. a root—may exhibit in different plants, or in different parts of the same individual, the author constantly insists that these are, in fact, due to a deviation from the ordinary course of growth which commonly culminates in the formation of a normal root. Similarly, though it is more difficult to prove the point owing to their greater variety (depending on their more varied environment), the author argues that the modified leaf structures; scales, thorns, and so on, are brought about by causes acting on the developing primordium of what would, if unchecked, become a foliage-leaf. This latter is for Goebel the actual typical leaf, and from it, by an exaggeration or attenuation of parts which are already recognisable during its earlier stages, the modification occurring in any given example proceeds. He strenuously opposes the view advocated by some writers that the leaf-primordium is an indifferent structure, and regards it as normally destined to give rise to an ordinary leaf. He has himself, more, perhaps, than any one else, shown how easy it is in some cases to interfere with those causes or sequences of events leading to the modification of such an organ, and thereby to effect a reversion in favour of the more primitive organ to take place. Probably most

people would be inclined to admit that, on the whole, the main lines of evidence go to prove that the obvious assumption made by Goebel in this connection with regard to the original character of the organ is a valid one.

It must, however, be confessed, and any one at all conversant with contemporary literature will recognise the fact, that there exists some danger of attaching a one-sided importance to the readiness with which organisms adapt themselves to the exigencies of a changed environment. For the response in form and structure is often so direct and obviously purposeful that more stress is apt to be laid on the stimulus itself than on the nature of the body to be stimulated, with its complex and varied mechanism, and there are some who have gone so far as to read into this purposeful variation an immediate explanation of the formation of new or incipient varieties; as though the real fact which mainly stands in need of analysis were not the very one constituted by this self-same *purposeful* character of the response. And indeed it would appear, upon reflection, that this form of response is itself the result of the operation of natural selection which has acted by eliminating the chance of leaving descendants from all those competitors in whom the reaction to a given set of conditions happened to fall short of a certain standard of perfection. It need not necessarily follow that all must have varied in an identical manner, but those that failed to comply, by *some* suitable change or another, with the requirements imposed by the new conditions, must inevitably be ousted by their more gifted rivals, and if these assumed changing conditions periodically recur, then the process of elimination will result in those only being left in which the power to respond accurately (*i.e.* purposefully), and it may be rapidly, to a particular change has been best developed and cultivated.

It is obvious that a similar result, *mutatis mutandis*, would follow if a complex variety of stimuli be substituted for the simple case touched on above, and thus a protoplasmic mechanism is gradually selected and perfected which, when stimulated by any means to which there can be a response at all, will reply by the corresponding reaction normal for that species or race. But though normal in kind for the race, its degree will vary in different individuals, as any one can readily prove by direct observation. Hence it at once becomes subject to the operation of natural selection. Naturally, so long as a particular stimulus is absent the corresponding response, however well tuned and ready, will remain in abeyance as a latent potentiality.

A study of plants reveals numerous examples of this. Amphibious plants frequently are able to assume alternative characters, respectively fitted for either a terrestrial or an aquatic habit, and it depends entirely on the nature of the stimulus arising from the environment as to which of the two types of structure shall appear. Such plants, during their species-life, have been repeatedly exposed to vicissitudes of a somewhat extreme character, and the latent ability to change so as to adapt themselves more fully to altered circumstances must have played no unimportant part in securing the survival of their race. Many other examples could be quoted to show how important for stationary beings like plants is the possession

of a very plastic organisation, that is, one which will respond readily and *accurately* to the demands of the external conditions of life. For plasticity is clearly only of use (and therefore will come to a like extent within the purview of natural selection) in so far as it will provide the organism with the power of striking the right note in response to a particular call.

On the other hand, there are plants which may have become, for example, specially selected on account of their ability to flourish in dry, hot, desert lands. Such plants might be expected to retain slender powers of responding in a manner favourable to the continuance of life under opposite hygrometric conditions; and every one is aware how extremely intolerant of moisture are the cacti and some other xerophytic plants. Nor is this surprising, seeing how trivial a part the development of a purposeful adaptation to satisfy the needs of a damp environment can have played in their ancestral experience, and indeed the chance of any individual amongst them possessing the power of responding quickly and appropriately to such conditions, to which they are never exposed, is an exceedingly remote one. It is otherwise with species that inhabit regions which, though usually dry, are occasionally or periodically exposed to different conditions. That the plants living in such places, though they may be mainly of a xerophytic habit, nevertheless retain the faculty of withstanding wet is precisely what one would have been led to anticipate, and there are plenty of examples in which the alternation of dry and wet seasons is accompanied by a change in habit analogous to that exhibited by our own trees in summer and winter respectively. An immense weight of evidence has been accumulated by those who have helped to elucidate these matters which goes to prove that the power to vary in any given direction is possessed in an unequal degree, not merely by individuals of the same species, but even in those growing side by side, and thus apparently exposed to very similar conditions.

This fact at once emphasises the importance of the preexisting *internal* factor of variation, and it also explains the existence of a criterion which can determine what individuals shall survive in the struggle imposed by new or changing conditions. The particular variation elicited in any given instance is merely the outward and visible sign of the operation of an inward organisation or mechanism. It is the latter which, forming an integral part of the parental constitution, will be transmitted to the offspring. And if those individuals which possess the special organisation in the highest degree are thereby enabled to leave the most vigorous or favourably situated descendants, that character, which is its outward token, will become correspondingly strengthened till it comes to form a mark of the race. It is the function of the environment to prove the individual capacity in that contest where the race is emphatically to the swift and the battle to the strong.

Hence, it would seem that not variability only, but that special (purposeful) form of it which enables so many organisms to make suitable responses to divergent conditions of life ought to be, as the outcome of the effect of natural selection, a feature of very general occurrence; and it ought to be most strongly developed in organisms living under changing or changeable conditions, and such

is found to be the case. One may almost assert that the purposefulness of a particular reaction is a measure of the perfectedness of the stimuable mechanism, itself a heritage transmitted through a long ancestral line of individual bodies.

This view of the matter is obviously in no wise altered, if we admit the occurrence of sudden or discontinuous variations. For these also are themselves congenital in their origin, and all that the environment can do is to encourage the manifestation of a variation (if a favourable one) in as high a degree as the organism can develop it. Nor is the position affected if we allow that a structural reaction may proximately result from a change in the metabolic processes of the organism, such as Sachs, and Goebel following him, have supposed. In fact, there are some familiar instances which hardly admit of any other explanation, as, for example, when different kinds of galls are produced on the same individual oak-tree by different insects. Facts such as these merely shift inquiry to another stage, and it is certainly not less difficult, in these and similar cases, to account for the particular antecedent reactions going on within the plant in such a way as to produce a substance capable of acting as an appropriate stimulus, which shall provoke a reaction in the plant useful to the grub which originates it.

Into the questions as to the origin of the causes of variations themselves, this is naturally not the place to enter; nor does a consideration of the problems concerned with the nature of those variations which may arise correlatively, or which are more or less obscurely conditioned by remote causes residing within the organism itself, and which may appear suddenly, without any immediate reference to their adaptedness to contemporary needs, fall within the scope of this article. It is enough to emphasise the point that the occurrence of purposeful reactions to specific stimuli is really in complete harmony with the operation of natural selection acting through the medium of a congenitally varying organisation.

Turning again to the subject-matter of Prof. Goebel's book, one finds that not only is it replete with interesting results of biological inquiries, but that there are scattered through its pages excellent little essays on morphological subjects. As an example of the former may be cited the explanation of the mechanism which brings about the dehiscence of the antheridia, a topic which has already formed the basis for investigations published from the author's laboratory. The instance of *Azolla*, too, in which the lower leaf lobe is shown to have an absorbent function, is attractive when the analogous case of *Salvinia* is recalled.

The critical treatment of the structure of the grass embryo is an admirable piece of comparative morphology. Prof. Goebel regards the cotyledon as consisting of the scutellum, epiblast and the sheath or coleoptile. His views are supported by evidence drawn from a consideration of a large number of other monocotyledons, especially the Cyperaceæ, and whether one agrees with his conclusions or not, one cannot but praise the way in which the evidence for them is collected and marshalled. The views put forward as to the homologies existing between the cells formed within the germinating microspores of some of the vascular cryptogams will probably provoke criticism, as will also the suggested phylogeny



of the gymnosperms, which the author appears to regard as derived partly from the Ferns and partly from the Lycopods.

As regards the book, viewed as a whole, it is impossible not to feel that, in spite of—perhaps partly in consequence of—its extraordinary wealth of illustration, it does not help us much farther towards a more general conception of the value and wider relations of organography as a whole. But, nevertheless, the experimental line of inquiry in this field, which Goebel himself has so ably pursued, is one which will certainly prove a fruitful one, judging from the results which have even yet accrued. And for the clear indication of this, as well as for the bringing together such a vast store of facts, the author has thoroughly earned the gratitude of his fellow-workers. It is just because there is so much of good in the book that it is difficult to avoid giving expression to that kind of gratitude which still hopes for something yet more satisfying.

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### THE HISTORY OF THE DEVIL.

*The History of the Devil and the Idea of Evil.* By Dr. Paul Carus. 8vo. pp. xvi+488. (London: Kegan Paul and Co., Ltd. Chicago: The Open Court Publishing Company, 1900.)

THE volume before us is one of considerable interest, but we must say at once that we think the history of the Devil and of the idea of evil should have been treated in a manner different from that which has been adopted by Dr. Paul Carus. The discussion of the idea of evil is a matter for the philosophical thinker, it seems to us, and the subject cannot be threshed out in detail in a single volume by any writer, however able he may be; the history of the manner in which the Devil, *i.e.*, the personification of evil, has been depicted by various peoples at various times in various places over the earth, is quite a different subject, and is, likewise, one which cannot be treated adequately in a single small volume. Dr. Carus, however, has tried to deal with *both* sides of this complex subject in one volume, and, it must be confessed, he will, in consequence, not satisfy either the philosopher or the iconographer. His book is well printed and well illustrated—though we certainly do not admire the shadowy “ghost” pictures printed in a sickly green colour on several of the pages—and to many readers it will be of interest, and probably of use also, for it may stimulate them to investigate the subject for themselves. In eighteen chapters, which vary considerably in length, the history of the Devil and the idea of evil are discussed in connection with the evidence derived from pictures, reliefs, &c., from Egypt, Akkad, Babylonia, Persia, Judea, India, China, Europe, and other countries, but Dr. Carus has not collected all the facts which he ought to have gathered together, and his deductions from those he gives are hardly correct. We do not think that “the belief in good spirits tended towards the formation of the doctrine of Monotheism,” or that “the belief in evil spirits led naturally to the acceptance of a single supreme evil deity.” Prehistoric man peopled all earth, air, sea and sky with spirits, some of whom were supposed to be hostile to him, and others benevolent; and he regarded a spirit as good or evil according to whether

it did him good or evil. When a series of good harvests came to him, or he was singularly fortunate in love, or the chase, or war, he made up his mind that the good spirits had succeeded in destroying the power of those who were evil. In process of time, to certain evil and to certain good spirits extraordinary powers were ascribed, and eventually the idea of the existence of a prince of evil, as well as of a prince of good, was formulated; terror and ignorance were the chief constituents in the worship of primitive man, and physical and moral attributes, as well as cause and effect, were often confounded by him.

Dr. Carus regards the old Egyptian god Set as the equivalent of the Devil of the later peoples of the West, but this is only partly true. He was a nature power and was the twin brother of Osiris according to one legend, and the twin brother of Horus the Elder according to another. He was the male counterpart of Nephthys who, as is well known, was not hostile to Osiris, and he must not be confounded with Ápep, the mighty enemy of Rā, the Sun-god; Set and Horus together held up the ladder whereby the deceased entered heaven, and both gods gave him a helping hand in mounting it. Dr. Carus is mistaken when he says that Set “was converted into Satan with the rise of the worship of Osiris.” We know nothing about the rise of the worship of Osiris, but we learn from the Pyramid Texts that in the fifth dynasty, when the worship of Osiris was universal in Egypt, Set was regarded as a benevolent god and a friend of the deceased. In speaking of Akkad and the early Semites, Dr. Carus is either credulous or rash, for, after saying that the Babylonians “possessed several legends which have been received into the Old Testament,” he mentions a legend of the Tower of Babel and of the “destruction of corrupt cities by a rain of fire,” reminding us of Sodom and Gomorrah. The text on which he relies for the legend of the Tower of Babel is, of course, K. 3657 in the British Museum, but a recent examination of the tablet proves that it has nothing to do with the Tower of Babel; as for the legend of the cities which were destroyed by “a rain of fire,” we cannot imagine what the authority can be. We may mention, in passing, that many of Dr. Carus’s authorities are altogether obsolete, and it is possible that one of them has led him astray on this point. His interpretations of Babylonian scenes, too, are not always correct. Thus on p. 40 the “Chaldean Trinity” is not blessing the tree of life, but is merely appearing above the conventionalised representation of the palm tree to the priest who is worshipping before the image of the god; similarly, the statement (p. 46) that the bronze tablet of the de Clercq Collection is a representation of “the world in the clutches of an evil demon” is erroneous. Any account of the demonology of the Assyrians and Babylonians which does not take into account the *Shunpu* and *Maklu* series of magical tablets which have been recently published by Tallquist and Zimmern must of necessity be most incomplete, and we are not a little surprised that Dr. Carus should have undertaken the task without doing so. The demonology of the Israelites is dismissed in nine pages, and this section of the book is most disappointing; in recent years many workers have investigated the Hebrew side of the subject of devil-lore, and an extremely interesting chapter might have been compiled from their writings. The famous